RELATIONSHIPS BETWEEN WATER COLOR AND SULPHATE MEASUREMENTS

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Recent studies in Nova Scotia indicated that highly colored, humic waters have higher $SO_4^=$ concentrations than that of clear or slightly colored waters (Kerekes et al., 1982; Thompson, 1982; Watt et al., 1983). This led to the interpretation that peaty soils release H_2SO_4 adding to that received from acid precipitation. In some cases when the role of peaty soils was not considered, the high $SO_4^=$ concentration or $SO_4^=$ export from the watershed was attributed solely to high $SO_4^=$ deposition from acid precipitation. In these studies the methyl thymol blue (MTB) method was used for $SO_4^=$ determination which overestimates $SO_4^=$ in colored waters (Anon., 1979).

Since November, 1981 we have measured $SO_4^=$ concentrations with both the MTB method used previously, and that of ion-chromatography (IC, Anon. 1983). It soon became obvious that the latter method gave consistently lower $SO_4^=$ values in colored, humic waters.

The five streams selected represent a wide range of water color and show varied seasonal patterns of $SO_4^=$ concentrations obtained by MTB and IC methods (Figs. 1 and 2). $SO_4^=$ concentrations were similar ($\simeq$ 2.0 mg/ℓ) by both methods in the clear Beaverskin Brook. By constrast, $SO_4^=$ concentrations were markedly different by the two methods in the highly colored Atkins Brook (50 to 280 Hazen u.), the differences in concentrations being greater when the water color was the highest. Marked seasonal trends were observed with both methods with MTB values ranging from 3.2 to 8.5 mg/ℓ and the IC values from 2.8 to 0.5 mg/ℓ. The lowest IC $SO_4^=$ values were found during the growing season (when both color and MTB $SO_4^=$ values were very high), which suggests a strong $SO_4^=$ reduction during that period. Similar results were also reported by Odgen (1981) in a pond receiving bog drainage near Halifax, N.S. A different pattern was noted in the highly colored Little River (50 to 160 Hazen u.). Although the IC values were consistently lower, they showed no marked seasonal variation in concentration. The IC values were ~ 2.0 mg/ℓ, similar to that of Beaverskin Brook while the MTB values were in the range of 2.5 to 3.8 mg/ℓ. The somewhat less colored Upper Mersey River showed a pattern similar to that of Little River except the $SO_4^=$ concentrations were slightly higher for both the MTB (2.8 to 4.6 mg/ℓ) and IC (1.9 to 3.6 mg/ℓ) methods. The slightly colored Grafton Brook (10 to 40 Hazen u.) showed consistently higher MTB values (2.5 to 2.8 mg/ℓ) vs. IC (2.0 to 2.4 mg/ℓ).

The possibility of correcting the MTB $SO_4^=$ values using the relationship between color and the difference between the concentrations obtained by the MTB and IC methods ($\Delta SO_4^=$) was explored (Figs. 3 and 4). A preliminary relationship based on limited data appeared promising in early

1982. However, when regression analysis was applied to both the pooled data (N = 305) and to each of the nine streams investigated (N = 12 to N = 26), it became obvious that the preliminary regression was no longer useful to correct MTB $SO_4^=$ from color. The relationship of the pooled data yielded a higher intercept, a lower slope and a lower regression coefficient. Furthermore the regression analysis on the individual stream basis showed that the color vs. $\Delta SO_4^=$ relationship varies among the streams. The highest regression coefficients were obtained in the most colored streams with the highest $\Delta SO_4^=$ values. The relationship is very weak with a very low slope and regression coefficient in the moderately colored Grafton Brook.

The sharp difference between the preliminary relationship and the pooled data may be due to a combination of seasonal and site specific factors which affect $\Delta SO_4^=$ (e.g., Fig. 2). The pooled data was collected throughout the year whereas the preliminary relationship employed data collected in the fall which resulted in a wider range of both color and $\Delta SO_4^=$ values in the former. Furthermore the relationship between color and $\Delta SO_4^=$ is not linear; the curve flattens when color exceeds approximately 150 Hazen units.

The variability of the color vs. $\Delta SO_4^=$ relationship among the individual streams suggests that until the seasonal and geographic effects on this relationship are better understood, a general correction procedure based on color for the historical MTB $SO_4^=$ data, except for crude estimates, should not be employed.

References

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Watt, W.D., Scott, D. and White, W.T., 1983. Evidence of acidification in some Nova Scotia rivers and impact on Atlantic salmon, Salmo salar. Can. J. Fish. Aquat. Sci. 40: 462-473.

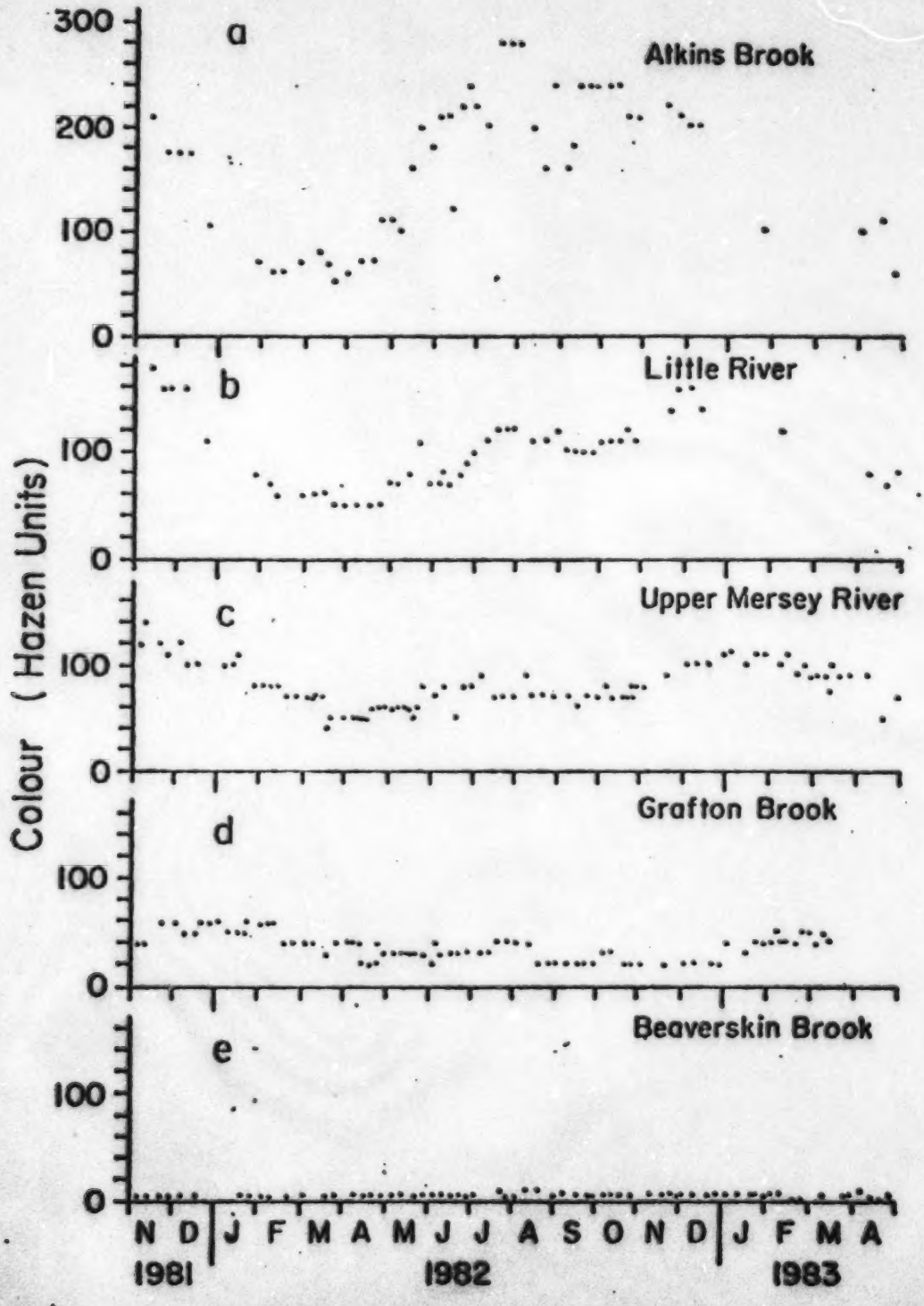

FIG. 1. Temporal changes of color (Hazen u.) in five streams in Kejimkujik National Park, Nova Scotia.

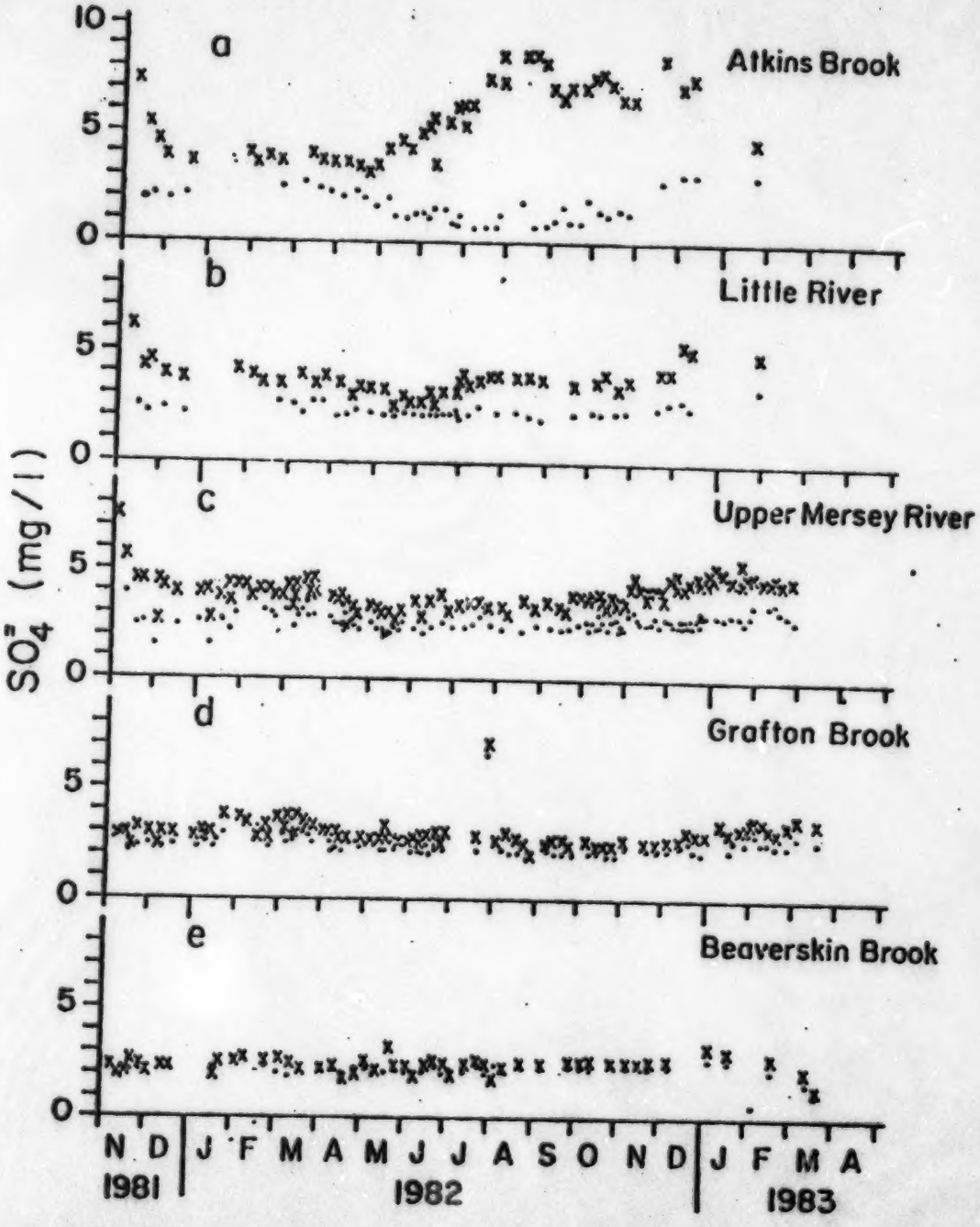

FIG. 2. Temporal changes of $SO_4^=$ concentrations (mg/l) by the methyl thymol blue and the ion chromatographic determination in five streams in Kejimkujik National Park, Nova Scotia.

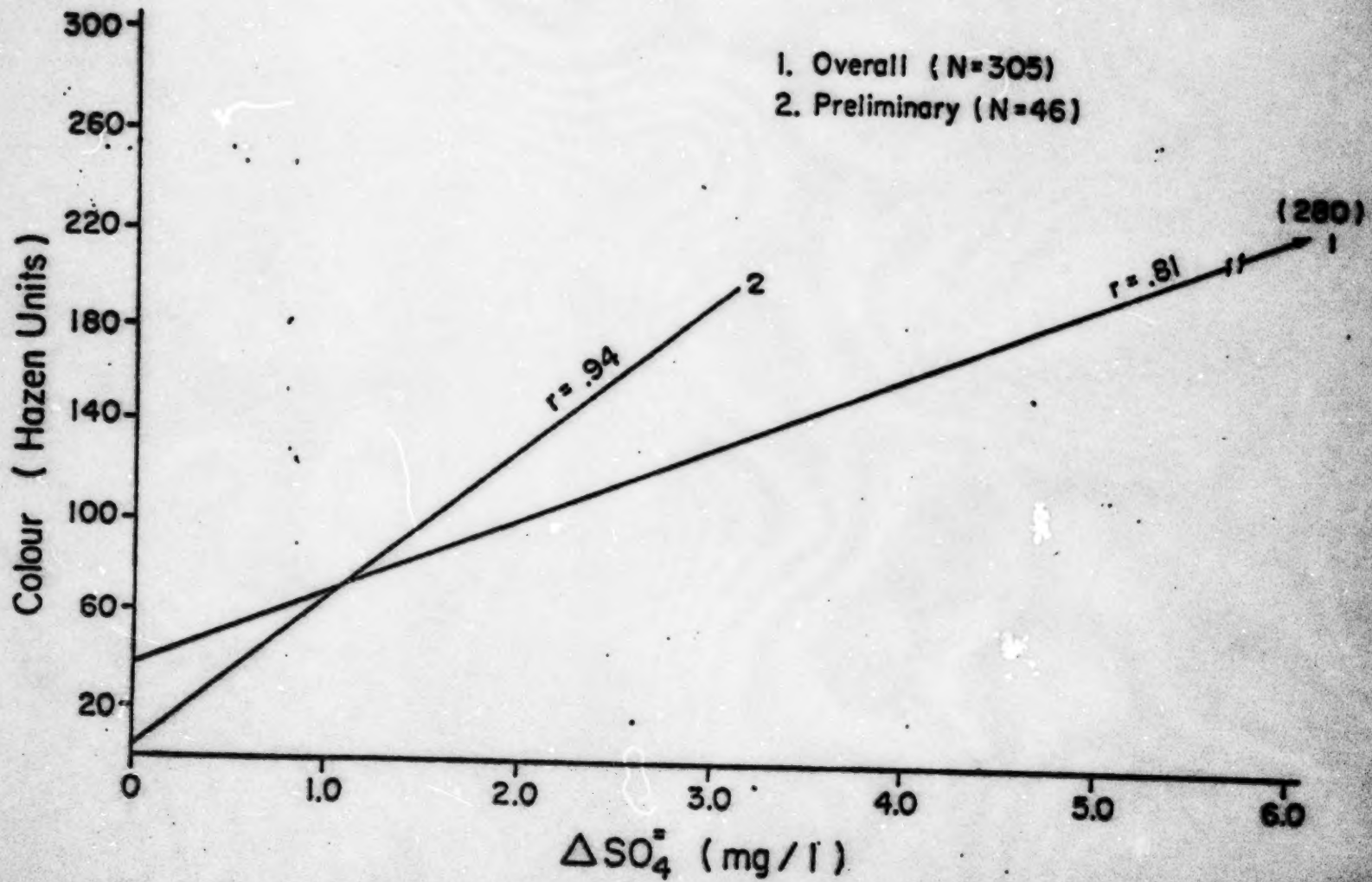

FIG. 3. Regression analysis of water color and the difference between methyl thymol blue and ion chromatographic sulphate ($\Delta SO_4^=$) concentrations for pooled data from nine streams in Kejimkujik National Park, Nova Scotia. Range of color indicated by the length of the regression line.

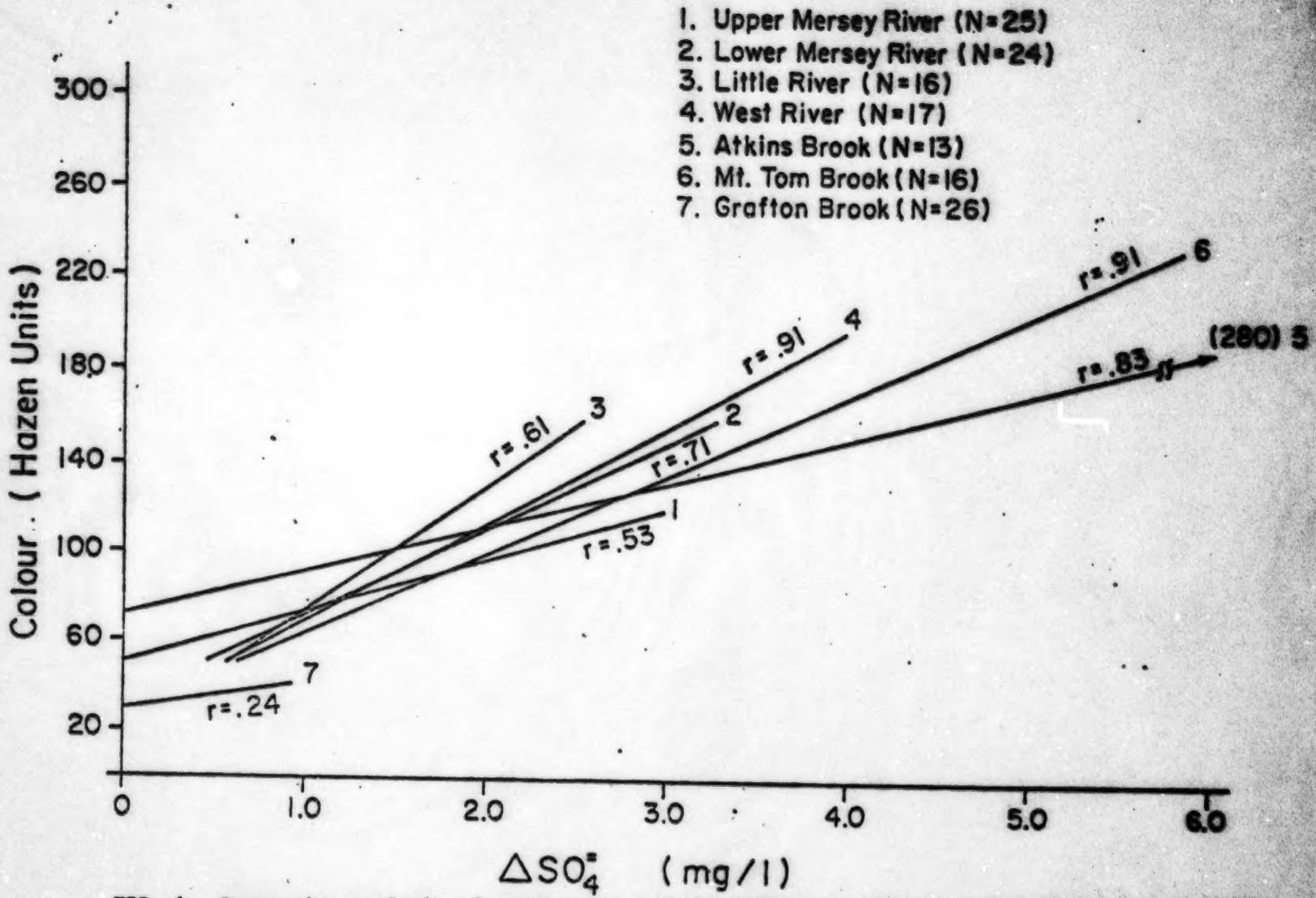

FIG. 4. Regression analysis of water color and the difference between methyl thymol blue and ion chromatographic sulphate ($\Delta SO_4^{=}$) concentration from nine streams in Kejimkujik National Park, Nova Scotia. Range of color indicated by the length of the regression line.